The Impact of Airbnb on the Housing Market: Estimates from New York City Before COVID-19

Sophie Calder-Wang

November 13, 2020
Motivation

- Rapid growth of the sharing economy facilitated by technology
  - Reduction in transaction costs
  - Under-utilized assets become accessible online
  - Services are produced by individuals rather than firms

- Prominent home-sharing platform Airbnb
  - YoY growth of over 30% for the last decade
  - Over 7 million listings, larger than any hotels
  - Transform the housing market

- Active political and regulatory debates
Active Political and Regulatory Debates

New York City Looks to Crack Down on Airbnb Amid Housing Crisis

By Zoe Greenberg
July 18, 2018

Judge Blocks New York City Law Aimed at Curbing Airbnb Rentals

By Benjamin Weiser and J. David Goodman
Jan. 3, 2019
What is the impact of the sharing economy on participants of the housing market?

- What is the welfare and distributional impact of Airbnb on renters of NYC?
  - **Utilization effects**
    - Benefit residents who share their homes
  - **Reallocation effects**
    - Raise rents as landlords reallocate housing units away
  - How does it vary by income, education, race, and family structure?
Setting: Airbnb in New York City

- Largest Airbnb market in the US
- Substantial variation by geography:
  - Chelsea, Williamsburg: > 8%
  - Dedicated entire homes: 0.7%
Approach

- A structural model of an integrated housing market
- Housing as a differentiated-product market with many attributes
- Heterogeneity in housing demand and Airbnb supply

Findings

1. Reallocation effects dominate the utilization effects for renters
   - Loss from rent increases: -$2.7bn
   - Gain from host surpluses: +$300mm

2. Increased rent burden falls more on high-income, educated, and white renters

3. Utilization gains help only a small fraction of low-cost hosts
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- A structural model of an integrated housing market
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1. Reallocation effects dominate the utilization effects for renters
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2. Increased rent burden falls more on high-income, educated, and white renters
3. Utilization gains help only a small fraction of low-cost hosts
Outline

1. Introduction
2. Literature and Data
3. Model
4. Counterfactuals
Literature

- Residential choices and housing policy:

- Nascent literature on the sharing economy:

- This paper:
  - The first structural model to estimate the impact of Airbnb on the housing market
  - Distributional implications through heterogeneous preferences
  - A novel way to estimate a heterogeneous supply system
Data

- Airbnb Usage
  - Scraped Airbnb.com data by a third party since 2014
  - Property characteristics:
    - Location (latitude and longitude)
    - Type of property, number of bedrooms
  - Detailed transaction-level data:
    - Daily performance of each property in New York
    - Price and quantity

- American Community Survey (ACS) Microdata
  - Individual-level housing choices
    - Demographics: Income, education, race, age, household size etc.
    - Housing: location, rent, physical attributes
    - Approximate neighborhoods:
      NYC has 55 public-use micro areas (PUMA)
Outline

1 Introduction
2 Literature and Data
3 Model
   1 A Stylized Model
   2 The Main Model
   3 Estimation
4 Counterfactuals
A Stylized Model
Reallocation from Long-term to Short-term Rental

Long-Term Rental Market

Short-Term Rental Market

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Long-Term Rental Market

Short-Term Rental Market
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Reallocation from Long-term to Short-term Rental

Long-Term Rental Market

\[ S^F - S^A \]

\[ P^L_1 \]

\[ P^L_0 \]

\[ D^L \]

Short-Term Rental Market

\[ S^H \]

\[ S^H + S^A \]

\[ P^S_0 \]

\[ D^S \]
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Transfer from renters to owners
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Transfer from renters to owners

Welfare loss for the displaced renters
A Stylized Model
Increased Utilization in Short-term Rental

Long-Term Rental Market

Short-Term Rental Market

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A Stylized Model

Increased Utilization in Short-term Rental

Long-Term Rental Market

Short-Term Rental Market

$P_0^L$, $P_1^L$, $P_0^S$, $P_1^S$
A Stylized Model
Increased Utilization in Short-term Rental

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Welfare loss from the rent channel

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Welfare loss from the rent channel
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Welfare gain from the host channel

Welfare loss from the rent channel

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Welfare loss from the rent channel

Welfare gain from the host channel

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The Impact of Airbnb on the Housing Market
Estimate the long-term rental demand to capture the loss from housing reallocation.
A Stylized Model

Summary

1. Estimate the **long-term rental demand** to capture the loss from housing reallocation
2. Estimate the **short-term rental supply** to capture the gain from increased utilization
Why A Structural Model?

Rationale:

1. Equilibrium effects
   - Households allowed to re-optimize
   - Neighborhoods without Airbnbs may also experience rent increases

2. Substitution patterns
   - Substitution towards similar housing types

3. Distributional implications
   - Random coefficients captures preference heterogeneity

Assumptions:

- Supply of physical structures for long-term rental is fixed
- Dynamic considerations are ignored
- Negative externalities are ignored
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      A. Demand and supply for long-term rental
      B. Demand and supply for short-term rental
      C. Market equilibrium
   3. Estimation
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Utility for household $i$ renting housing unit $j$ of type $h$:

$$u_{i,j}^L = \alpha_i^L \cdot p_h^L + \beta_i^L \cdot x_h^L + \xi_h^L + \epsilon_{i,j}^L$$

- $x_h^L$: Including physical attributes, neighborhood attributes, location attributes
- Dividing the housing stock in 1050 types
Model Part A. Demand for Long-Term Rental

Utility for household \( i \) renting housing unit \( j \) of type \( h \):

\[
  u_{i,j}^L = \alpha_i^L p_h^L + \beta_i^L X_h^L + \xi_h^L + \epsilon_{i,j}^L
\]

- \( X_h^L \):
  - Including physical attributes, neighborhood attributes, location attributes
  - Dividing the housing stock in 1050 types
- Heterogeneous coefficients \( \alpha_i^L, \beta_i^L \) are functions of demographics \( z_i \)
Model Part A. Demand for Long-Term Rental

- Utility for household $i$ renting housing unit $j$ of type $h$:

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- Unobserved quality $\xi_h^L$, allowed to be correlated with price
Model Part A. Demand for Long-Term Rental

Utility for household $i$ renting housing unit $j$ of type $h$:

$$ u_{i,j}^L = \alpha_i^L p_h^L + \beta_i^L X_h^L + \xi_h^L + \epsilon_{i,j} $$

- $\alpha_i^L$: price coefficient
- $p_h^L$: rental price
- $\beta_i^L$: household-specific preference
- $X_h^L$: housing attributes
- $\xi_h^L$: unobserved quality

- $X_h^L$:
  - Including physical attributes, neighborhood attributes, location attributes
  - Dividing the housing stock in 1050 types
  - Heterogeneous coefficients $\alpha_i^L, \beta_i^L$ are functions of demographics $z_i$
  - Unobserved quality $\xi_h^L$, allowed to be correlated with price

Individual optimization: $y_i^L = j \iff u_{i,j}^L > u_{i,-j}^L$

Long-term rental demand for housing type $h$:

- Integral of all those who choose $h$: $D_h^L(p_h^L, p_{-h}^L) = \int_{A_h^L} dP(\epsilon^L)dP_D^*(z)$
- $z_i$ is drawn from the distribution of the entire metro market
Model Part A. Supply of Long-Term Rental

- The supply of physical structures available for long-term rental is **fixed** at $S_h^F$

- Market clearing without Airbnb:

  $$\forall h \; : \; D_h^L(p_h^L, p_{-h}^L) = S_h^F$$

- Market clearing with Airbnb reallocation:

  $$\forall h \; : \; D_h^L(p_h^L, p_{-h}^L) = S_h^F - S_h^A(p_h^L, p_h^A, \cdot)$$
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Model Part B: Supply of Short-Term Rental
By Absentee Landlords

- An absentee landlord reallocates from long-term to short-term if more profitable
- Quantity reallocated depends on prices in both markets:
  \[ S^A_h(p^L_h, p^A_h, \cdot) \]

  - \( S^A_h \) obtained from data
Model Part B: Supply of Short-Term Rental
By Residents

Utility of providing an Airbnb room for household $i$ in neighborhood $n$ on day $t$:

$$ u_{i,t} = \alpha_i p_{n,t}^A + \beta_i X_{n,t}^R + \xi_{n,t} + \epsilon_{i,t} $$

- $\alpha_i$: price coefficient
- $p_{n,t}^A$: Airbnb price for a room in nbhd. $n$
- $\beta_i$: household-specific cost of hosting
- $X_{n,t}^R$: constant, time FEs
- $\xi_{n,t}$: unobserved cost
- $\epsilon_{i,t}$: unobserved cost
- $\alpha_i$ and $\beta_i$ for the constant term is a function of demographics
- Unobserved cost $\xi_{n,t}$ allowed to be correlated with price
Model Part B: Supply of Short-Term Rental By Residents

Utility of providing an Airbnb room for household $i$ in neighborhood $n$ on day $t$:

$$u_{i,t}^R = \alpha_i^R p_{n,t}^A + \beta_i^R X_{n,t}^R + \xi_{n,t}^R + \epsilon_{i,t}^R$$

- $\alpha_i^R$ and $\beta_i^R$ for the constant term is a function of demographics $z_i$
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  - $\alpha_i^R$ and $\beta_i^R$ for the constant term is a function of demographics $z_i$
  - Unobserved cost $\xi_{n,t}^R$ allowed to be correlated with price

- Resident $i$ hosts if better than alternative personal use: $y_{i,t}^R = 1 \iff u_{i,t}^R > 0$

- Short-term rental supply in neighborhood $n$ day $t$:
  - Integral of all those who host: $S_{n,t}^R(p_{n,t}^A) = \int_{A_{n,t}^R} dP(\epsilon_{n,t}^R) dP_{D_n}^*(z)$
  - $z_i$ drawn from neighborhood $n$
Model C: Market Equilibrium

- A sorting equilibrium characterized by the price vectors:
  \[ p^L_h, p^A_h. \]

- Clearing of the long-term rental market of each type:
  \[ \forall h : \quad D^L_h(p^L_h, p^L_{-h}) = S^F_h - S^A_h(p^L_h, p^A_h) \]  
  (1)

- Clearing of the short-term rental market of each type each period:
  \[ \forall h, t : \quad D^A_{h,t}(p^A_{h,t}, p^A_{-h,t}) = S^A_{h,t}(p^L_{h,t}, p^A_{h,t}) + S^R_{h,t}(p^A_{h,t}) \]  
  (2)
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Estimation of Long-Term Rental Demand: Overview

Long-term rental utility for household $i$ for housing unit $j$ of type $h$:

$$u_{i,j}^L = \alpha_i^L p_h^L + \beta_i^L x_h^L + \xi_h^L + \epsilon_{i,j}^L$$

$$\begin{bmatrix} \alpha_i^L \\ \beta_i^L \end{bmatrix} = \begin{bmatrix} \alpha^L \\ \beta^L \end{bmatrix} + \begin{bmatrix} \pi_{\alpha,1}^L & \cdots & \pi_{\alpha,K}^L \\ \pi_{\beta,1}^L & \cdots & \pi_{\beta,K}^L \end{bmatrix} \begin{bmatrix} Z_{i,1} \\ \vdots \\ Z_{i,k} \end{bmatrix}$$

- $\alpha_i^L$ and $\beta_i^L$ are common to all households.
- $\alpha^L$ and $\beta^L$ are household-specific.
- $\pi_{\alpha,1}^L, \cdots, \pi_{\alpha,K}^L$ and $\pi_{\beta,1}^L, \cdots, \pi_{\beta,K}^L$ are identified from individual-level choices.
- Moment conditions are used for estimation.

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Estimation of Long-Term Rental Demand: Overview

- Long-term rental utility for household $i$ for housing unit $j$ of type $h$:
  \[
  u_{i,j}^L = \alpha_i^L p_h^L + \beta_i^L x_h^L + \xi_h^L + \epsilon_{i,j}^L
  \]

\[
\begin{bmatrix}
\alpha_i^L \\
\beta_i^L
\end{bmatrix} = \begin{bmatrix}
\alpha^L \\
\beta^L
\end{bmatrix} + \begin{bmatrix}
\pi_{\alpha,1}^L & \cdots & \pi_{\alpha,K}^L \\
\pi_{\beta,1}^L & \cdots & \pi_{\beta,K}^L
\end{bmatrix} \begin{bmatrix}
Z_{i,1} \\
\vdots \\
Z_{i,K}
\end{bmatrix}
\]

- Moment conditions
  - Cov (housing attributes, household characteristics) to identify $\pi_{b,k}^L$

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Estimation of Long-Term Rental Demand: Overview

- Long-term rental utility for household $i$ for housing unit $j$ of type $h$:
  \[ u_{i,j}^L = \alpha_i^L p_h^L + \beta_i^L x_h^L + \xi_h^L + \epsilon_{i,j}^L \]

\[
\begin{bmatrix}
\alpha_i^L \\
\beta_i^L
\end{bmatrix}
= \begin{bmatrix}
\alpha^L \\
\beta^L
\end{bmatrix}
+ \begin{bmatrix}
\pi_{\alpha,1}^L & \cdots & \pi_{\alpha,K}^L \\
\pi_{\beta,1}^L & \cdots & \pi_{\beta,K}^L
\end{bmatrix}
\begin{bmatrix}
Z_{i,1} \\
\vdots \\
Z_{i,k}
\end{bmatrix}
\]

  common to all

  household-specific

  BLP instruments adapted for housing

  Identified from individual-level choices

- Moment conditions
  - Cov (housing attributes, household characteristics) to identify $\pi_{b,k}^L$
  - Housing attributes as product characteristics
    - Relative scarcity in housing attributes acts as a supply shifter
## Estimation of Long-Term Rental Demand: Results

<table>
<thead>
<tr>
<th>WTP ($ mo)</th>
<th>Demographic Characteristics</th>
<th>Nbhd. Attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ln Income</td>
<td>HH Size</td>
<td>Black</td>
</tr>
<tr>
<td>Pct Black (Std)</td>
<td>56.7</td>
<td>-47.9</td>
</tr>
<tr>
<td>(20.3)</td>
<td>(15.9)</td>
<td>(232.6)</td>
</tr>
<tr>
<td>Pct Hispanic (Std)</td>
<td>56.3</td>
<td>-22.8</td>
</tr>
<tr>
<td>(19.9)</td>
<td>(9.4)</td>
<td>(115.8)</td>
</tr>
<tr>
<td>Pct Asian (Std)</td>
<td>47.8</td>
<td>-14.3</td>
</tr>
<tr>
<td>(16.9)</td>
<td>(7.1)</td>
<td>(39.0)</td>
</tr>
<tr>
<td>Pct College (Std)</td>
<td>145.9</td>
<td>-54.0</td>
</tr>
<tr>
<td>(45.7)</td>
<td>(18.5)</td>
<td>(68.1)</td>
</tr>
<tr>
<td>Inside NYC</td>
<td>-337.8</td>
<td>-421.2</td>
</tr>
<tr>
<td>(106.9)</td>
<td>(128.6)</td>
<td>(97.6)</td>
</tr>
<tr>
<td>Commuting Time (Std)</td>
<td>38.7</td>
<td>-6.3</td>
</tr>
<tr>
<td>(19.9)</td>
<td>(11.9)</td>
<td>(56.9)</td>
</tr>
</tbody>
</table>
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<table>
<thead>
<tr>
<th>Housing Attributes</th>
<th>WTP ($ mo)</th>
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</tr>
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<tbody>
<tr>
<td></td>
<td>Ln Income</td>
<td>HH Size</td>
</tr>
<tr>
<td>One Bedroom</td>
<td>75.8 (31.2)</td>
<td>255.1 (78.6)</td>
</tr>
<tr>
<td>Two Bedroom</td>
<td>59.1 (28.8)</td>
<td>520.5 (156.4)</td>
</tr>
<tr>
<td>Three Bedroom</td>
<td>32.4 (28.7)</td>
<td>717.6 (214.9)</td>
</tr>
<tr>
<td>Four Bedroom</td>
<td>85.0 (66.7)</td>
<td>884.9 (266.0)</td>
</tr>
<tr>
<td>Built After 1980</td>
<td>22.4 (14.7)</td>
<td>-35.9 (13.7)</td>
</tr>
<tr>
<td>Built 1940-1980</td>
<td>-102.6 (34.3)</td>
<td>6.1 (10.1)</td>
</tr>
<tr>
<td>5+ Units</td>
<td>9.7 (9.5)</td>
<td>58.6 (18.6)</td>
</tr>
<tr>
<td>Monthly Rent</td>
<td>0.33 (0.10)</td>
<td>-0.03 (0.02)</td>
</tr>
</tbody>
</table>
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<table>
<thead>
<tr>
<th></th>
<th>(1) OLS</th>
<th>(2) Instrumented</th>
<th>(3) ($) WTP Mo.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monthly Rent ($k)</td>
<td>0.0213</td>
<td>-2.044***</td>
<td>454.5***</td>
</tr>
<tr>
<td></td>
<td>(0.0341)</td>
<td>(0.609)</td>
<td>(78.2)</td>
</tr>
<tr>
<td>One-Bedroom</td>
<td>0.425***</td>
<td>0.929***</td>
<td>648.2***</td>
</tr>
<tr>
<td></td>
<td>(0.0447)</td>
<td>(0.188)</td>
<td>(93.5)</td>
</tr>
<tr>
<td>Two-Bedroom</td>
<td>0.528***</td>
<td>1.325***</td>
<td>681.0***</td>
</tr>
<tr>
<td></td>
<td>(0.0465)</td>
<td>(0.280)</td>
<td>(76.7)</td>
</tr>
<tr>
<td>Three-Bedroom</td>
<td>0.271***</td>
<td>1.392***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0555)</td>
<td>(0.393)</td>
<td></td>
</tr>
<tr>
<td>Built After 1980</td>
<td>-0.114***</td>
<td>0.139</td>
<td>68.2</td>
</tr>
<tr>
<td></td>
<td>(0.0402)</td>
<td>(0.145)</td>
<td>(60.9)</td>
</tr>
<tr>
<td>Built 1940 to 80</td>
<td>-0.00917</td>
<td>-0.242**</td>
<td>-118.4**</td>
</tr>
<tr>
<td></td>
<td>(0.0337)</td>
<td>(0.105)</td>
<td>(43.9)</td>
</tr>
<tr>
<td>5+ Units</td>
<td>0.00182</td>
<td>-0.209**</td>
<td>-102.3**</td>
</tr>
<tr>
<td></td>
<td>(0.0282)</td>
<td>(0.0974)</td>
<td>(41.2)</td>
</tr>
<tr>
<td>Commuting Time (Std)</td>
<td>0.119***</td>
<td>-0.782***</td>
<td>-382.6***</td>
</tr>
<tr>
<td></td>
<td>(0.0215)</td>
<td>(0.279)</td>
<td>(28.2)</td>
</tr>
<tr>
<td>Inside NYC</td>
<td>-1.026***</td>
<td>2.536**</td>
<td>1240.7***</td>
</tr>
<tr>
<td></td>
<td>(0.0683)</td>
<td>(1.036)</td>
<td>(147)</td>
</tr>
</tbody>
</table>

- First stage F-statistics is 15.7
- Aggregate price elasticity $\epsilon$: 1.0
  - 1.0% contraction in supply
  - 1.0% increase in price

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<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
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<tbody>
<tr>
<td>N</td>
<td>1050</td>
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      C. Market equilibrium
   3. Estimation

4. Counterfactuals
Outline

1. Introduction
2. Literature and Data
3. Model
   1. A Stylized Model
   2. The Main Model
      A. Demand and supply for long-term rental
      B. Demand and supply for short-term rental
      C. Market equilibrium
   3. Estimation
4. Counterfactuals
Utility of providing an Airbnb room for household $i$ in neighborhood $n$ on day $t$:

$$u_{i,t}^R = \alpha_i^R p_{n,t}^A + \beta_i^R x_{n,t}^R + \xi_{n,t}^R + \epsilon_{i,t}^R$$

$$\begin{bmatrix} \alpha_i^R \\ \beta_i^R \end{bmatrix} = \begin{bmatrix} \alpha^R \\ \beta^R \end{bmatrix} + \begin{bmatrix} \pi_{\alpha,1}^R & \cdots & \pi_{\alpha,K}^R \\ \pi_{\beta,1}^R & \cdots & \pi_{\beta,K}^R \end{bmatrix}\begin{bmatrix} Z_{i,1} \\ \vdots \\ Z_{i,k} \end{bmatrix}$$

- Common to all
- Household-specific
Estimation of Short-Term Rental Supply: Overview

- Utility of providing an Airbnb room for household \( i \) in neighborhood \( n \) on day \( t \):

\[
 u_{i,t}^R = \alpha_i^R p_{n,t}^A + \beta_i^R x_{n,t}^R + \xi_{n,t}^R + \epsilon_{i,t}^R
\]

\[
 \begin{bmatrix}
 \alpha_i^R \\
 \beta_i^R
 \end{bmatrix}
 = \begin{bmatrix}
 \alpha^R \\
 \beta^R
 \end{bmatrix}
 + \begin{bmatrix}
 \pi_{\alpha,1}^R \cdots \pi_{\alpha,K}^R \\
 \pi_{\beta,1}^R \cdots \pi_{\beta,K}^R
 \end{bmatrix}
 \begin{bmatrix}
 Z_{i,1} \\
 \vdots \\
 Z_{i,k}
 \end{bmatrix}
\]

common to all \hspace{1cm} household-specific

- Novel:
  - Adapt BLP to estimate the peer production function with random coefficients
  - Match market shares in each neighborhood and every day
    - Over 70,000 market-share observations: MPEC

- Use demand seasonality to instrument for price
- Multiple markets with demographic variations
Estimation of Short-Term Rental Supply: Overview

- Utility of providing an Airbnb room for household \( i \) in neighborhood \( n \) on day \( t \):
  \[
  u_{i,t}^R = \alpha_i^R p_{n,t}^A + \beta_i^R x_{n,t}^R + \xi_{n,t}^R + \epsilon_{i,t}^R
  \]

- \( \alpha_i^R \) and \( \beta_i^R \) are common to all households.
- \( \xi_{n,t}^R \) is household-specific.

- Use demand seasonality to instrument for price.
- Multiple markets with demographic variations.

- Novel:
  - Adapt BLP to estimate the peer production function with random coefficients.
  - Match market shares in each neighborhood and every day.
    - Over 70,000 market-share observations: MPEC.

- Price instrument:
  - Seasonality in tourism demand.
    - Number of hotel bookings in NYC on the same day seven years ago.
    - Month, day of week, and holiday FE.
### Estimation of Short-Term Rental Supply: Results

<table>
<thead>
<tr>
<th></th>
<th>(1) Naive</th>
<th>(2) Naive</th>
<th>(3) IV</th>
<th>(4) IV</th>
<th>(5) ($ per diem)</th>
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<tbody>
<tr>
<td><strong>Linear Coef.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Price</td>
<td>0.006</td>
<td>0.007</td>
<td>0.052</td>
<td>0.056</td>
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<tr>
<td></td>
<td>(0.002)</td>
<td>(0.001)</td>
<td>(0.002)</td>
<td>(0.002)</td>
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</tr>
<tr>
<td>$x \ln(\text{income})$</td>
<td>-0.018</td>
<td>-0.018</td>
<td>-0.018</td>
<td>-0.011</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td>(0.002)</td>
<td>(0.003)</td>
<td>(0.006)</td>
<td></td>
</tr>
<tr>
<td><strong>Non-Linear Coef.</strong></td>
<td></td>
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<tr>
<td>Cost</td>
<td>15.44</td>
<td>15.51</td>
<td>22.07</td>
<td>21.36</td>
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<tr>
<td></td>
<td>(0.10)</td>
<td>(0.09)</td>
<td>(0.12)</td>
<td>(0.11)</td>
<td>(12.7)</td>
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<tr>
<td>$x \text{Has College}$</td>
<td>-1.17</td>
<td>-2.55</td>
<td>-3.47</td>
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<td>-58.9</td>
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<tr>
<td></td>
<td>(0.68)</td>
<td>(0.24)</td>
<td>(0.27)</td>
<td>(0.25)</td>
<td>(4.8)</td>
</tr>
<tr>
<td>$x \text{Has Children}$</td>
<td>2.40</td>
<td>2.58</td>
<td>1.95</td>
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<td>46.7</td>
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<tr>
<td></td>
<td>(0.42)</td>
<td>(0.36)</td>
<td>(0.53)</td>
<td>(0.44)</td>
<td>(8.1)</td>
</tr>
<tr>
<td>$x \text{Age (yr)}$</td>
<td>0.094</td>
<td>0.093</td>
<td>0.091</td>
<td>0.097</td>
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</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td>(0.005)</td>
<td>(0.006)</td>
<td>(0.006)</td>
<td>(0.1)</td>
</tr>
<tr>
<td>$x \ln(\text{income})$</td>
<td>0.24</td>
<td>-0.14</td>
<td>-0.39</td>
<td>-0.29</td>
<td>-5.1</td>
</tr>
<tr>
<td></td>
<td>(0.09)</td>
<td>(0.13)</td>
<td>(0.26)</td>
<td>(0.48)</td>
<td>(8.7)</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td><strong>Month FE</strong></td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td><strong>Day of Week FE</strong></td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td><strong>Holiday FE</strong></td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
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<tr>
<td><strong>N</strong></td>
<td>75,895</td>
<td>75,895</td>
<td>75,895</td>
<td>75,895</td>
<td></td>
</tr>
</tbody>
</table>

- First-stage F: 25.4
- Supply elasticity $\epsilon$: 5.96
  - Income $-1$std: 6.70
- Low-cost suppliers:
  - Have college degrees
  - Have no children
  - Young
Outline

1Introduction
2Literature and Data
3Model
4Counterfactuals
   1 Loss from the Rent Channel (Reallocation Effects)
   2 Gain from the Host Channel (Utilization Effects)
   3 Net Welfare Impact
Overview of the Welfare Analysis

Distribution of Net Welfare Impact on Renters

- Blue: loss from the rent channel
- Green: gain from the host channel

Net welfare impact on renters:
- Orange

$welfare\ p.a.$

Density
Overview of the Welfare Analysis

Distribution of Net Welfare Impact on Renters

- Blue: loss from the rent channel
- Green: gain from the host channel

Net welfare impact on renters:
- 50th percentile: $-125

$welfare p.a.
Overview of the Welfare Analysis

Distribution of Net Welfare Impact on Renters

- Blue line: loss from the rent channel
- Green line: gain from the host channel

50th: $-125
98th: $0

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The Impact of Airbnb on the Housing Market
Overview of the Welfare Analysis

Distribution of Net Welfare Impact on Renters

- Loss from the rent channel
- Gain from the host channel

50th: $-125
98th: $0
>99th: $164
Loss from the Rent Channel (Reallocation Effects)

1. Counterfactual specification:
   - “Return” reallocated housing units to the long-term rental market

2. Recompute the new market-clearing equilibrium prices:
   \[ \forall h : D_h^L(p_h^{L, \text{No Airbnb}}, p_{-h}^L, \text{No Airbnb}) = S_h^F \]  
   - Fraction of the total housing market reallocated to Airbnb: 0.68%
   - Average rent change due to the reallocation: 0.71%

3. Compensating variation for logit errors:
   \[ CV_i^L = \frac{1}{\alpha_i^L} \left( \ln \sum_{j \in S^F \setminus S^A} \exp(V_{i,j}^L) - \ln \sum_{j \in S^F} \exp(V_{i,j}^{L, \text{No Airbnb}}) \right) \]  
   - CV computed for all renters in the city
Loss from the Rent Channel
Distribution by Household Demographics
Loss from the Rent Channel
Distribution by Household Demographics

Distribution of Housing Types

- % Long-term rental units
- % Short-term rental units

Number of Bedrooms vs. Fraction
- <=1: 46% (46%), 82% (orange)
- 2: 37% (blue), 13% (orange)
- 3: 16% (blue), 4% (orange)
- >=4: 2% (blue), 2% (orange)
Loss from the Rent Channel
Distribution by Household Demographics

Loss from the Rent Channel (by Race & Ethnicity)

$ on Renters (p.a.)

-300
-250
-200
-150
-100

White & Other  Black  Hispanic  Asian

-152  -134  -113  -127
Loss from the Rent Channel

Distribution by Household Demographics

Percentage Airbnb Reallocation

0.01 - 0.07
0.07 - 0.11
0.11 - 0.17
0.17 - 0.23
0.23 - 0.27
0.27 - 0.44
0.44 - 1.05
1.05 - 1.26
1.26 - 1.99
1.99 - 3.40
Loss from the Rent Channel
Distribution by Household Demographics

Percentage Airbnb Reallocation

Fraction White
Loss from the Rent Channel
Distribution by Household Demographics

Percentage Airbnb Reallocation

Fraction Black

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Loss from the Rent Channel
Distribution by Household Demographics

Percentage Airbnb Reallocation

Fraction Hispanic

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Loss from the Rent Channel
Distribution by Household Demographics

Percentage Airbnb Reallocation

Fraction with College Degrees

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Loss from the Rent Channel
Distribution by Household Demographics

Loss from the Rent Channel (by Education)

$ on Renters (p.a.)

-300
-250
-200
-150
-100

No College
College

-120
-156
Loss from the Rent Channel

Distribution by Household Demographics

Loss from the Rent Channel (by Income Quintiles)

$ on Renters (p.a.)

-124
-125
-126
-134
-167

0-20% 20-40% 40-60% 60-80% 80-100%
Drivers of Distributional Differences:

1. Geography
   - More Airbnb reallocation in high-income, educated, and white neighborhoods

2. Willingness-to-Pay
   - Higher-income households have higher WTP for all housing attributes
   - Geography remains dominant
     - Comparison to a hypothetical uniform Airbnb entry

3. Demographic Clustering
   - Housing preferences are clustered along demographic lines
   - “Spreading” to neighborhoods with similar demographics
     - White, educated neighborhoods further away from city centers
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   2. Gain from the Host Channel (Utilization Effects)
   3. Net Welfare Impact
Gain from the Host Channel (Utilization Effects)

1. Counterfactual specification:
   - Take away residents ability to host on Airbnb

2. Compensating variation for logit errors:
   
   \[ CV_i^R = \frac{1}{\alpha_i^R} \sum_t \ln (1 + \exp(V_{i,t}^R)) \]
   
   \[ V_{i,t}^R = \alpha_i^R p_{n,t}^A + \beta_i^R x_{n,t}^R + \xi_{n,t}^R \]
Gain from the Host Channel (Utilization Effects)

1. Counterfactual specification:
   - Take away residents' ability to host on Airbnb

2. Compensating variation for logit errors:
   \[ CV_i^R = \frac{1}{\alpha_i^R} \sum_t \ln \left( 1 + \exp(V_{i,t}^R) \right) \]
   \[ V_{i,t}^R = \alpha_i^R p_{n,t}^A + \beta_i^R x_{n,t}^R + \xi_{n,t}^R \]

Distribution of Host Gains

- 50th: $0.4

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The Impact of Airbnb on the Housing Market
Gain from the Host Channel (Utilization Effects)

1. Counterfactual specification:
   - Take away residents ability to host on Airbnb

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   \[ V_{i,t}^R = \alpha_i^R p_{n,t} + \beta_i^R X_{n,t} + \xi_{n,t} \]

Distribution of Host Gains

- 50th: $0.4
- 90th: $45.6
- >99th: $307.4

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The Impact of Airbnb on the Housing Market
Gain from the Host Channel (Utilization Effects)

1. Counterfactual specification:
   - Take away residents ability to host on Airbnb

2. Compensating variation for logit errors:

\[ CV_i^R = \frac{1}{\alpha_i^R} \sum_t \ln \left( 1 + \exp \left( V_{i,t}^R \right) \right) \]

\[ V_{i,t}^R = \alpha_i^R p_{n,t}^A + \beta_i^R X_{n,t}^R + \xi_{n,t}^R \]
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Net Welfare Impact on Renters

- The reallocation channel dominates the utilization channel
  - The median renter making $47k loses $125 p.a.
  - Larger welfare losses suffered by educated and high-income renters
  - Losses widespread, gains concentrated

- Aggregate and capitalize the impact:

![Graph showing the impact on rental markets]
Net Welfare Impact for the Social Planner

- The social planner’s problem:
  - Renters
  - Owners
  - Tourists and hotels
Net Welfare Impact for the Social Planner

- The social planner’s problem:
  - Renters
  - Owners
  - Tourists and hotels

Renters’ Loss from Reallocation: $-2.7bn
Renters’ Host Gains: $0.3bn
Net Impact on Renters: $-2.4bn
Net Welfare Impact for the Social Planner

- Renters’ Loss from Reallocation: $-2.7bn
- Renters’ Host Gains: $0.3bn
- Owners’ Transfer from Renters: $2.7bn
- Owners’ Host Gains: $0.7bn
- Net Impact on Renters: $-2.4bn
- Net Impact on Housing Market Participants: $1bn

The social planner’s problem:
- Renters
- Owners
- Tourists and hotels

The city planner’s problem:
- The median resident is a renter
The social planner’s problem:

- Renters
- Owners
- Tourists and hotels

Renters’ Loss from Reallocation: -$2.7bn
Renters’ Host Gains: $0.3bn
Owners’ Transfer from Renters: $2.7bn
Owners’ Host Gains: $0.7bn
Net Impact on Renters: -$2.4bn
Net Impact on Housing Market Participants: $1bn
Total Impact: $2.6bn

Tourists Net of Hotels: $1.6bn
Net Welfare Impact for the Social Planner

- The social planner’s problem:
  - Renters
  - Owners
  - Tourists and hotels

- The city planner’s problem:
  - The median resident is a renter

The city planner’s problem:
- The median resident is a renter

Renters' Loss from Reallocation: $-2.7bn
Renters' Host Gains: $0.3bn
Owners' Transfer from Renters: $2.7bn
Owners' Host Gains: $0.7bn
Tourists Net of Hotels: $1.6bn
Net Impact on Renters: $-2.4bn
Net Impact on Housing Market Participants: $1bn
Total Impact: $2.6bn
Limitations / Extensions

- Long-term rental demand unchanged
  - No income effects
  - No re-optimization based on expected host gains

- A frictionless, static approximation
  - No switching costs
  - No explicit rent stabilization
Concluding Thoughts

- The impact of Airbnb on NYC residents:
  - Built a structural model of an integrated housing market:
    - Material welfare losses suffered by most renters (-$2.4bn NPV)
    - Rich preference heterogeneity for the distributional impact:
      - Larger losses for high income, educated, and white renters
      - Host gains accrue to a concentrated few

- What are the policy implications?
  - The popular solution is to restrict Airbnb reallocation
    - A reverse transfer from property owners back to renters
    - Reduce aggregate welfare

- The importance of existing market structures for policy
  - An inelastic housing supply remains the underlying challenge
  - How the pie is cut will affect the size of the pie
Thank you!